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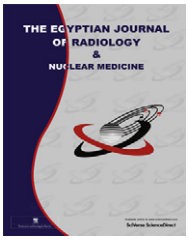

ORIGINAL ARTICLE

Does MRI help in the assessment of inflammatory breast disorders?

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KEYWORDS

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Abstract *Objective:* The aim of work is to evaluate the role of magnetic resonance imaging in the assessment of different entities of inflammatory breast disorders.
Materials and methods: Eighty-one non-lactating patients with mastitis had been evaluated by post contrast MR imaging; their ages ranged from 22 to 70 years (Average age: 41.6 years). MRI data analysis was performed regarding qualitative criteria and parametric color maps for image post processing. Diagnosis was made up regarding resolution in follow up sessions for simple mastitis and biopsy were done for cases with suspicious imaging findings.
Results: Mammary interstitial edema with no masses or abnormal enhancement was elicited in 28.4% (n = 23/81). T2-weighed and post contrast series were the sequences of choice to rely upon in evaluation. T2 had demonstrated lesions in 64.2% (n = 52/81) and contrast uptake was detected in 68% (n = 55/81). Quantitative analysis was overlapping.
MR imaging had displayed sensitivity, specificity and accuracy of 87.5%, 72.3%, and 75.4% respectively in differentiating benign forms of mastitis from malignant ones.
Conclusion: In inflammatory breast disorders, MR imaging can precisely delineate disease extent and monitor response to therapy. Immediate distinction between infectious/non-infectious and malignant mastitis is difficult to be obtained.

1. Introduction

In general mastitis is inflammation of the breast that may or may not be accompanied by infection. The term mastitis is often used synonymous with breast infection (1), but strictly speaking mastitis is inflammation of the breast irrespective of the cause (2).

Having mastitis does not raise the woman's risk of developing breast cancer. However, an uncommon type of breast cancer known as the inflammatory breast cancer (IBC) has

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symptoms that are similar to mastitis and can be sometimes mistaken as infection (3).

Imaging plays several key roles in the diagnosis and assessment of IBC. These include characterization of the known tumor, delineation of locoregional disease in the ipsilateral and contralateral breast and regional lymph node basins, diagnosis of distant metastases, and evaluation of treatment response (4).

Complete resolution is usually the rule in most cases of mastitis. If after 10 days of antibiotics symptoms of mastitis do not dissipate, inflammatory carcinoma should be ruled out and punch skin biopsy skin biopsy (that included skin and dermal lymphatics) should be performed (2).

If after biopsy the diagnosis remains unclear, breast MR may help to (a) demonstrate the success of the antibiotic treatment and (b) diagnose coexisting or confounding inflammatory carcinoma (5).

The purpose of the study was to assess the impact of MR imaging in the evaluation of different entities of inflammatory breast disorders and discuss its potential ability to differentiate infectious/non-infectious from malignant mastitis.

2. Materials and methods

2.1. Materials

Eighty-one *non-lactating* female patients were clinically or pathologically diagnosed of mastitis had been referred to the Radiology Department, Women's imaging unit, Cairo University from June 2010 to July 2011. All patients gave informed consent. Their ages ranged from 22 to 70 years (Average age: 41.6 years).

Lactating females or cases with dermal rather mammary inflammation had been excluded from the evaluation.

Cases were classified into three main groups of mastitis according to previous retrospective study performed on 2009 [2], which had postulated a three group classification for the different entities of inflammatory breast disorders as follows: *group 1* infectious mastitis; *group 2* non-infectious mastitis, and *group 3* malignant mastitis.

The categories in our work were in *group 1* simple, complicated (abscess and infected cysts) and specific mastitis (T.B.); *group 2* periductal mastitis, granulomatous mastitis, diabetic mastopathy and secondary mastitis (fat necrosis, postoperative and chemo-radiotherapy changes, scleroderma, systemic lupus erythematosus, sarcoidosis) and *group 3* inflammatory breast carcinoma (IBC).

No malignant abscess cases were detected through the research duration.

Cases with post operative chemo-radiotherapy changes ($n = 14$) are known cases of breast cancer with management-related likely inflammatory changes.

2.2. Methods

All patients were subjected to complete medical history and full clinical examination by their referring physicians. Cases were obliged to bring such data at the time of imaging.

Ultrasound examination was performed for all the cases by 8–12 MHz linear array transducer (General Electric (GE), Logic 7 machine).

Full Field Digital Mammography was performed using GE Senograph 2000 Machine. Standard craniocaudal and mediolateral oblique views were obtained; with the axilla included in the latter. Regarding the clinical condition of the breast (degree of inflammation), mammography was not feasible in all cases; it was performed in 53 out of 81 cases (64.5%).

2.2.1. Magnetic resonance imaging

Sequentional post contrast MRI was performed for all cases using a 1.5-T magnet (Gyroscan Entra, Philips medical systems, Netherland).

MR examination of the breast was requested for more precise evaluation of the abnormality extent and/or specification of the etiological entity (if possible).

Cases were examined first by pre-contrast sequences: Axial T1-weighted sequence spinecho (SE)-(TR/TE 500/5.3 ms), sagittal and axial T2-weighted sequences SE (TR/TE 120/4.9 ms) and axial T2-weighted inversion recovery (IR)-(TR/TE 80/6.5 ms). For all the aforementioned sequences slice thickness = 4 mm, matrix = 512×192, flip angle = 90° and FVO = 34–37 cm. Six dynamic 3D "T1 High Resolution Isotropic Volumetric Examination" THRIVE acquisition was used – 1 before and 5 after power injection of 0.1 mmol/kg BW of contrast (Gd-DTPA) with the parameters (TR/TE 2.8/9 ms) and slice thickness = 1.5 mm.

2.3. Image analysis

Image analysis and imaging–guided biopsy had been performed by qualified consultant of Radiology (M.S.), who is M.D. certified (lecturer) and has 9 years experience in breast MR imaging and interventional procedures performance.

Second look MR image analysis and surgical procedures had been performed by qualified consultant of surgery (A.A.), M.D. certified (lecturer) 9 years experience in breast surgery and imaging.

The authors were blinded about the mammography and ultrasound findings as well as the pathology results at the time of initial evaluation. Also they were blinded about each other MRI analysis. At the stage of final evaluation, there was multidisciplinary discussion of cases between the consultants.

On breast MRI, data analysis was performed regarding qualitative (morphology) and quantitative (kinetic) criteria.

In the pre-contrast series, findings indicative of inflammation had been looked for: (1) diffuse or focal skin thickening, (2) diffuse or sectoral interstitial edema, (3) focal collections, (4) diffuse soft tissue infiltrations, (5) focal mass and (6) lymph node enlargement.

Post contrast series were assessed for enhancement recognition.

The different patterns of enhancement of the inflammatory entities included in the study will be discussed in the results sector as it has been retrospectively assessed.

Kinetic analysis was applicable using a Phillips Advantage windows workstation with functional Tool software. For image post processing; region of interest (ROI) measurement of abnormally enhancing areas was performed using parametric color maps to determine the lesion enhancement rate peak and time.

Lesions that are strongly and rapidly enhancing were displayed in red, whereas slowly or weakly enhancing lesions had appeared blue or green. Automated Slope enhancement

ratio curves (SER) and Maximum relative enhancement percentage (MRE%) were obtained.

Ultrasound guided core biopsies of the breast were performed in 66.7% (n = 54/81) of the cases using 14-gauge needle.

In cases of IBC, punch skin biopsy was done. Biopsy site from the breast parenchyma was also performed guided by the degree of tissue induration (the harder the tissue; the more liable to be pathologically involved).

Surgical biopsy had been performed for six cases as follows:

- Three cases of IBC had shown inconclusive tissue sample by previous US guided core biopsy (granulation tissue with no malignant cells detected).
- One case of granulomatous mastitis and another one with tuberculous (T.B.) mastitis had undergone partial mastectomy with latissimus dorsi flap application as the disease was extensive and resistant to medical treatment.
- One case of post operative fat necrosis; in such case the lesion was indistinct by ultrasound it was only noted in relation to the scar region at MR imaging.

Nodal ultrasound guided core biopsy was performed in 26 cases as follows: 68.7% of IBC (n = 11/16), 77.7% of tuberculous (n = 7/9), and all of simple mastitis, scleroderma, sarcoidosis and systemic lupus cases.

Surgical nodal biopsy was done for two cases of IBC.

The choice of using surgical vs US guided core biopsy of axillary nodes was decided according to the size and location of the node of question.

Fine needle aspiration cytology of axillary nodes was performed in three IBC and two T.B. cases.

Abscess cavities (n = 6), infected cysts (n = 7) and postoperative collections (n = 4/14 cases) were drained under US guidance. Cytological assessment was then performed.

All cases of simple mastitis (n = 9) and active periductal mastitis (n = 2) were followed up after 1 month and 3 months by ultrasound and post contrast MRI respectively to ensure condition amelioration. Follow up request and duration was decided by the referring physician.

For statistical analysis, software (SPSS for Windows, version 10.0.1, 1999; SPSS, Chicago, Ill) had been used.

3. Results

The current study included 81 non-lactating patients that were complaining of mastitis. The frequency and relative frequencies (percentage) of cases included under each pathological entity listed in Table 1.

Groups 1 and 2 represented infectious and non-infectious forms of mastitis in the study (65/81 cases-80.3%) and group 3 represented malignant mastitis in the form of IBC (16/81 cases-19.7%).

Group 1: 31 cases (age range: 22–56 years, mean: 35.6 and Std: 7.3), group 2: 34 cases (age range: 24–65 years, mean: 41.3 and Std: 9.3) and group 3: included the malignant entity of 16 cases (age range: 40–70 years, mean: 53.8 and Std: 8.4).

Mammary interstitial edema with no masses or abnormal contrast uptake was elicited in 28.4% (n = 23/81) (Fig. 1) – Table 2.

T2WI FSE and post contrast series were the sequences of choice to rely upon in evaluation.

T2 had demonstrated lesions in 64.2% (n = 52/81) seen in 17 cases of group 1, 21 cases in group 2 and 14 cases in group 3; that had elicited the following patterns: (1) bright, (2) intermediate-bright and (3) intermediate-low patterns – Table 3.

In groups 1 and 2 (benign mastitis, n = 38/52); T2 WI had shown bright signal in 36.9% (n = 14/38), intermediate-bright signal in 44.7% (n = 17/38) (Figs. 2 and 3) and intermediate-low signal in 18.4% (n = 7/38). In group 3 (malignant mastitis, n = 14/52); T2 WI detected masses of intermediate-low soft tissue infiltration in 100% (14/14) of IBC cases (Fig. 5).

Contrast uptake was detected in 68% (n = 55/81); benign mastitis (groups 1 and 2) had represented 20 cases for each and 15 cases in group 3 of malignant mastitis. Retrospective analysis of enhancement patterns were as follows: (1) marginal (Fig. 2), (2) discrete patchy, (3) focal mass (Fig. 4), (4) combined focal and patchy, and (5) infiltrative diffuse enhancement (Figs. 3 and 5) – Table 4.

Patterns of contrast enhancement in benign mastitis (n = 40/55) were marginal in 32.5% (n = 13/40), discrete patchy in 20% (n = 8/40), focal mass in 27.5% (n = 11/40), combined focal and patchy 17.5% (n = 7/40) and infiltrative diffuse enhancement 2.5% (n = 1/40).

Group 3 that represents malignant mastitis in the form of IBC (n = 15/55) had shown infiltrative diffuse enhancement pattern in 80% of these cases (n = 12/15). Discrete patchy, focal mass and combined focal and patchy enhancement patterns had been displayed by the remaining three cases: one case for each pattern.

Quantitative analysis was applied for the enhancing lesions regarding MRE% and the curve pattern.

For the sake of the patient, the worst curve was the one to be considered for lesions with different curve patterns, especially when malignant mastitis was suspected.

MRE% range of 70–150% were detected in 60% (n = 33/55), 150–250% in 27.3% (n = 15/55), >250% in 12.7% (n = 7/55).

Table 1 The incidence of pathological entities included in the study.

Pathology of mastitis	No. of lesion/patient	(%)
Group 1: Infectious	31	38.2
*Simple	9	
*Complicated	13	
Abscess cavity	6	
Infected cysts	7	
*Specific mastitis	9	
Tuberculosis (T.B.)	9	
Group 2: Non-infectious	34	42
*Periductal mastitis/duct ectasia	2	
*Granulomatous mastitis	3	
*Diabetic mastopathy	2	
*Secondary mastitis	27	
Fat necrosis	6	
Postoperative/chemo-radiotherapy	14	
Scleroderma	2	
Systemic lupus erythematosus	3	
Sarcoidosis	2	
Group 3: Malignant	16	19.8
*Inflammatory carcinoma	16	
Total	81	100

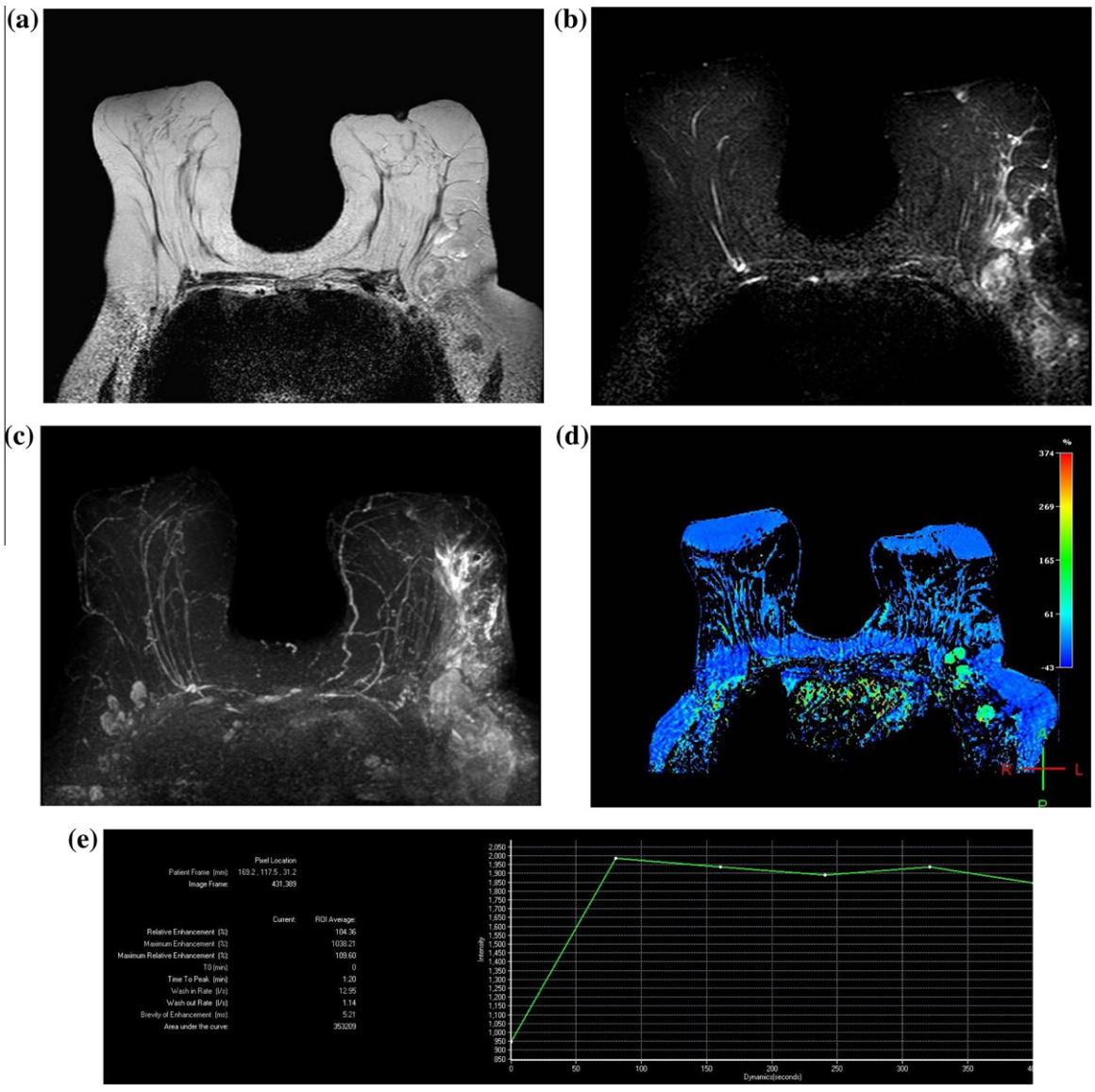

Fig. 1 Known case of metatstatic non-Hodgkin lymphoma. Axial (a) T2-weighted, (b) T2-STIR and (c) 3D MIP reconstructed T2-STIR show left axillary pathologically enlarged and amalgamated nodes. Ipsilateral upper outer quadrant tissue edema of patchy bright SI. Note the right side benign looking axillary nodes with preserved fatty hilum. (d) Post contrast axial image at 2.4 min of the dynamic series with color overlay. (e) Time/SI analysis of one of the enlarged nodes shows early uptake at 120 s. with corresponding SI% of 109% and type III (early wash out) curve.

Benign mastitis cases had shown 70–150% in 67.5% (n = 27/40), 150–250% in 20% (n = 8/40), and >250% in 12.5% (n = 5/40). In Malignant mastitis, cases had shown 70–150% in 40% (n = 6/15), 150–250% in 46.7% (n = 7/15), and >250% in 13.3% (n = 2/15).

Type I of *continuous rise* curve pattern (suggestive of benign kinetics) was noted in 34.5% (n = 19/55), type II of *plateau* curve pattern (borderline) was seen in 54.5% (n = 30/55) and type III most likely malignant curve pattern with *early wash out* was seen in 11% (n = 6/55).

Groups 1 and 2 of benign mastitis had shown type I curve in 47.5% (n = 19/40) (Figs. 2 and 4), and type II curve in 47.5% (n = 19/40), where delayed peak of contrast uptake that may suggest probably benign kinetics displayed in 10 cases and early peak with suspicious impression in 9 cases. Type III curve pattern was elicited by only 5% (n = 2/40) (Fig. 3) of these cases.

Group 3 (malignant mastitis) had presented the following curve patterns: delayed peak plateau curve pattern in 6.6% (n = 1/15), early peak plateau curve pattern in 66.7% (n = 10/15) and type III pattern in 26.7% (n = 4/15) (Fig. 5).

Contrast-enhancement with no definite mass detection on T2WI had been demonstrated in three cases 7% (n = 6/81) as follows: three simple mastitis, two periductal mastitis and one IBC cases.

Diabetic mastopathy cases and one case of fat necrosis had shown no appreciable contrast uptake.

Skin thickening was noted in 55.5% (n = 45/81). Out of them twenty cases had shown associate post contrast skin enhancement (n = 21/45–46.6%); these cases include: 14 IBC

Table 2 Inflammatory Breast Entities with Solo Breast Edema in our Study.

Edema é no masses (n = 23 cases)	No.
Group 1: Infectious	31
Simple	6
Abscess	–
Infected cysts	–
T.B.	5
Group 2: Non-infectious	34
Periductal mastitis	–
Granulomatous mastitis	–
Diabetic mastopathy	–
Fat necrosis	–
Postoperative-chemotherapy	4
Scleroderma	2
Systemic lupus	3
Sarcoidosis	2
Group 3: Malignant	16
IBC	1
Total	23/81

cases (Fig. 5), and one case of granulomatous mastitis (Fig. 3) and six cases of the post operative chemo-radiotherapy sector.

T1WI was only helpful in some cases of complicated cysts, abscesses and fat necrosis masses. Such lesions had shown characteristic bright signal intensity. Suppressed lesions in the post contrast THRIVE series verify fatty elements (Fig. 4) suggestive of fat necrosis especially if there was history of trauma or previous interventional procedure.

Concerning axillary nodes, they were detected in 74 cases as follows: Average sized in 27.1% (n = 22/81) (Fig. 5), enlarged discrete in 60.5% (n = 49/81) (Figs. 2 and 3) and enlarged amalgamated in two T.B. cases and in one case of pathologically proven metastatic non-Hodgkin lymphoma (n = 3/81–3.57%). Enlarged lymph nodes in the latter case had compressed the axillary vein; consequent ipsilateral breast congestion and resultant simple mastitis took place (Fig. 1). Such case had performed surgical resection of the pathological axillary nodes. Subsequent fade out of the mastitis noted in the follow up examination.

Indistinct central fatty hilum was noted in 11 cases of the pathologically enlarged lymph nodes (Fig. 1), almost all of them were IBC (10 cases).

Axillary nodes could not be depicted in 8.6% (n = 7/81) as they were outside the field of view. Nodes kinetic were non-specific; SI% was within 80–130%. Peak of contrast uptake was early in 23% (n = 17/74) cases and delayed in 77% (n = 57/74) cases followed by wash out.

In the current study dynamic post contrast MRI had displayed true positive outcome in 14 cases, true negative in 47 cases, false positive in 18 cases and false negative in two cases. MRI had shown sensitivity, specificity, accuracy, positive predicative value and negative predicative value of 87.5%, 72.3%, 75.4%, 44% and 96% respectively regarding its ability to evaluate inflammatory breast disorders.

4. Discussion

Breast infection can occur in healthy, non-lactating women of all ages. It remains a challenge to distinguish acute mastitis from malignancy, especially form inflammatory breast carcinoma (IBC), by clinical or imaging features (6).

Unfortunately, there is a paucity of references discussing the role of MRI in evaluating inflammatory breast disorders.

Table 3 T2-weighted signal intensities of the current inflammatory breast disorders.

Mastitis/T2 SI; n = 52/81 cases	Bright	Intermediate-bright	Intermediate-low
Group 1: Infectious (n = 17/31)			
Simple	–	–	–
Abscess	3	3	–
Infected cysts	7	–	–
T.B.	–	2	2
Total	10/17 (58.8)	5/17 (29.4)	2/17 (11.8)
Group 2: Non-infectious (n = 21/34)			
Periductal mastitis	–	–	–
Granulomatous mastitis	–	3	–
Diabetic mastopathy	–	1	1
Fat necrosis	4	2	4
Postoperative-chemotherapy	–	6	–
Scleroderma	–	–	–
Systemic lupus	–	–	–
Sarcoidosis	–	–	–
Total	4/21 (19.1)	12/21 (57.1)	5/21 (23.8)
Group 3: Malignant (n = 14/16)			
IBC	–	–	14
Total	–	–	14/14 (100)

Note: Data are reported as number (percent).
SI = Signal intensity.

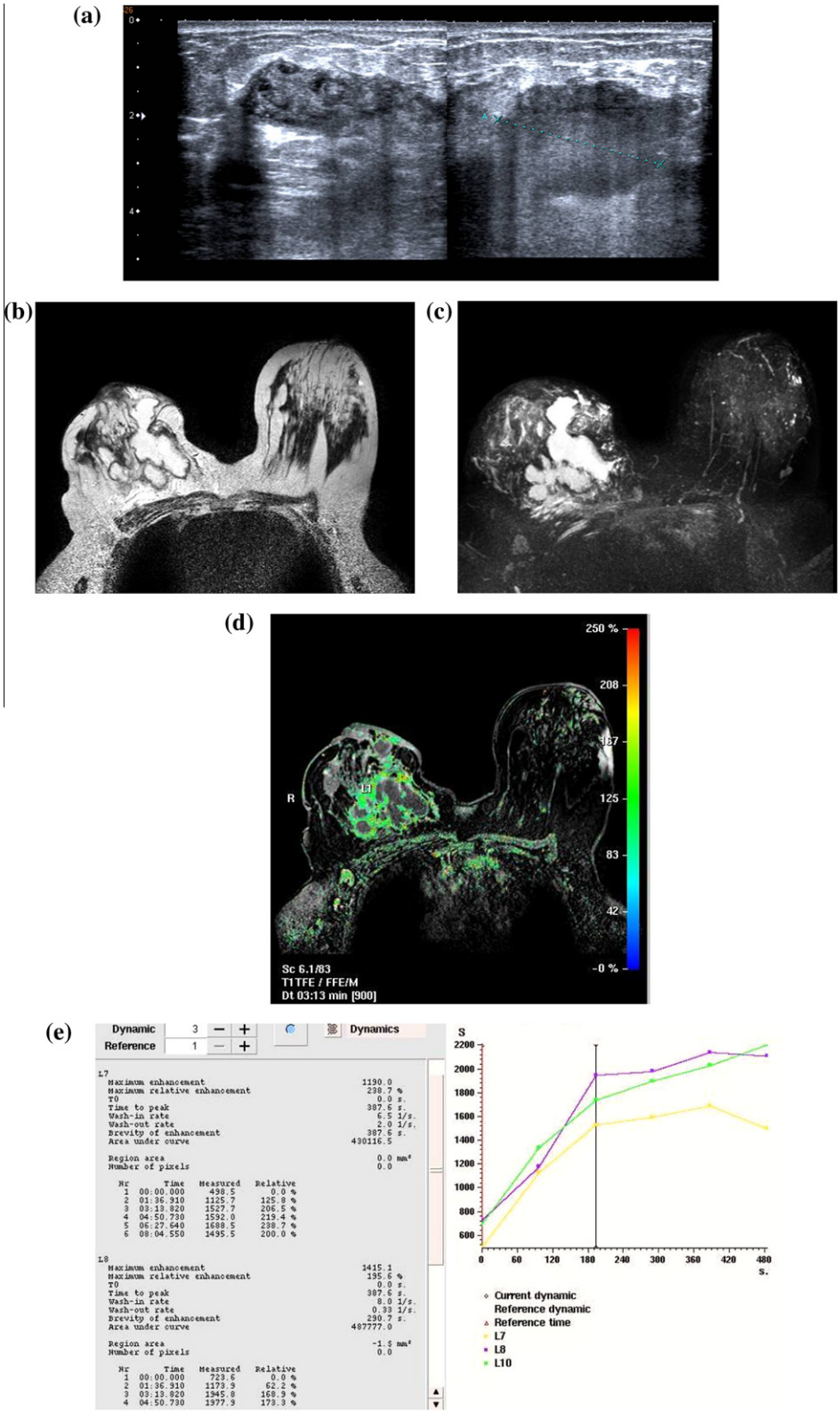

Fig. 2 Right breast tuberculous abscess. (a) Gray-scale US image shows false impression of soft tissue infiltration. Axial (b) T2-weighted and (c) 3D MIP reconstructed T2 STIR show thick-walled multi-locular cystic lesion of intermediate-high SI attributed to its turbid inspissated content. The entire extend of the right breast abscess as well as the ipsilateral enlarged axillary node can be easily seen in (c). (d) Axial THRIVE image 3.3 min post contrast with color overlay, shows intense marginal enhancement of the abscess cavity. (e) Time/SI analysis shows delayed peak of contrast uptake at 387sec. with corresponding SI% of 238–195% and type I (continuous rise) benign curve pattern.

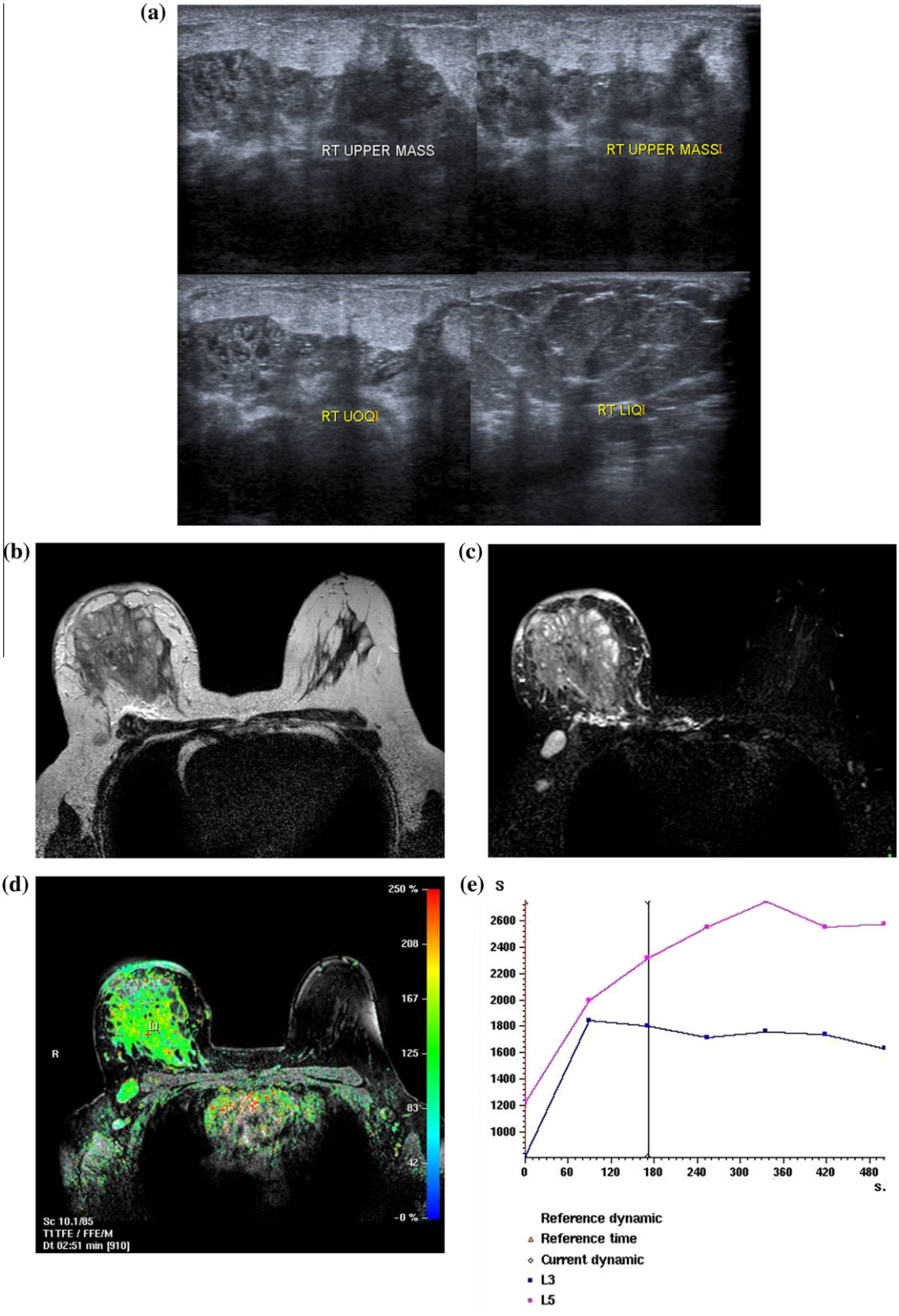

Fig. 3 Right breast non-specific granulomatous mastitis. (a) Gray-scale US image shows false impression of soft tissue infiltration. Axial (b) T2-weighted and (c) T2 STIR images show the breast is studded with multiple variable sized complicated cystic spaces mingled with diffuse tissue infiltration of intermediate-high SI. Note right diffuse skin thickening, peri-pectoral edema and ipsilateral axillary enlarged node. (d) Axial THRIVE image 3.3 min post contrast with color overlay shows intense enhancement of the breast infiltration and marginal enhancement of the associate cystic spaces. Note faint insignificant skin enhancement. (e) Time/SI analysis shows early peak of contrast uptake at 89sec. with corresponding SI% of 126% and type III (early wash out) curve pattern.

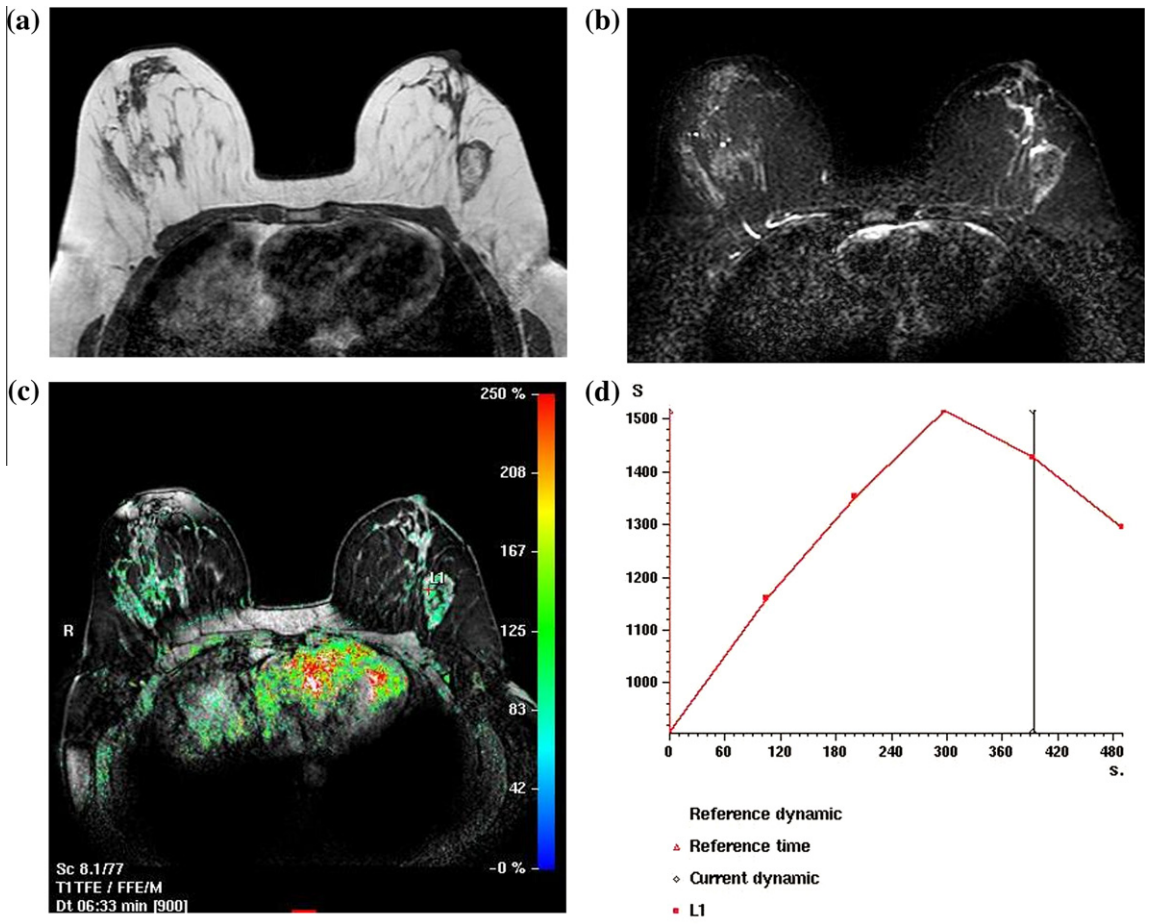

Fig. 4 Left breast post malignant lumpectomy fat necrosis. Axial (a) T1-weighted and (b) T2-STIR that shows oval-shaped mass of fat-near SI related to the scar line that had been suppressed in (b) confirming fatty components. (c) Axial THRIVE image 8 min post contrast with color overlay shows heterogenous enhancement. (d) Time/SI analysis shows delayed peak of contrast uptake at 393 s. with corresponding SI% of 81% and type I benign curve pattern.

Fischer et al. (7) in 1994 stated that neither signal behavior nor signal/time relation were suitable to differentiate between malignant and benign changes. They concluded that inflammatory changes of the female breast are not indicated to be examined with MR imaging.

Rieber et al. (5) in 1997 also reported MRI breast to show no significant difference between mastitis and inflammatory carcinoma, and Al-Khawari et al. (8) stated that the inclusion of chronic inflammatory lesions in their study was the main reason for a reduced MRI accuracy since such modality is not a good tool for the differentiation of benign from malignancy in such a clinical situation.

In the current study dynamic post contrast MRI had displayed sensitivity, specificity, accuracy, positive predictive value and negative predictive value of 87.5%, 72.3%, 75.4%, 44% and 96% respectively in the evaluation of inflammatory breast disorders.

Renz et al. (6) in 2008 compared the ability of MRM examinations in distinguishing inflammatory breast carcinomas from acute mastitis. They had found out that considering multiple dynamic and morphological MRM criteria seems to have the potential for a differential diagnosis.

Inflammatory breast cancer (IBC) being rare is often misdiagnosed as mastitis or generalized dermatitis (9).

IBC cases in the current study using MR imaging had been evaluated probably regarding the actual extend of the neoplasm, associate dermal, lymph node and chest wall involvement (Fig. 5). Concerning the previously mentioned data; response to the neoadjuvant therapy for such cases could be easily followed up.

In this study, the following features were observed more often in IBC cases: Intermediate-low SI in T2WI, early contrast uptake (blooming sign), and in one case there was additional peri- and intramuscular pectoral edema and enhancement (Fig. 5). The aforementioned findings had helped in distinguishing IBC from chronic inflammatory conditions especially granulomatous mastitis (Figs. 5 and 3).The latter had shown differential T2 WI SI of intermediate – high pattern.

T2-weighted signal hyperintensity within the viable (enhancing) portion of the lesion is highly suggestive of benign histology (10).

Qualitative criteria especially T2-weigthed SI and presence of contrast uptake were the items that helped during the evaluation in significant number of cases.

Through analyzing the different patterns of contrast uptake elicited in the study, we could observe that: benign mastitis (groups 1 and 2) had shown rather comparable presentation of marginal (32.5%), discrete patchy (20%), focal mass

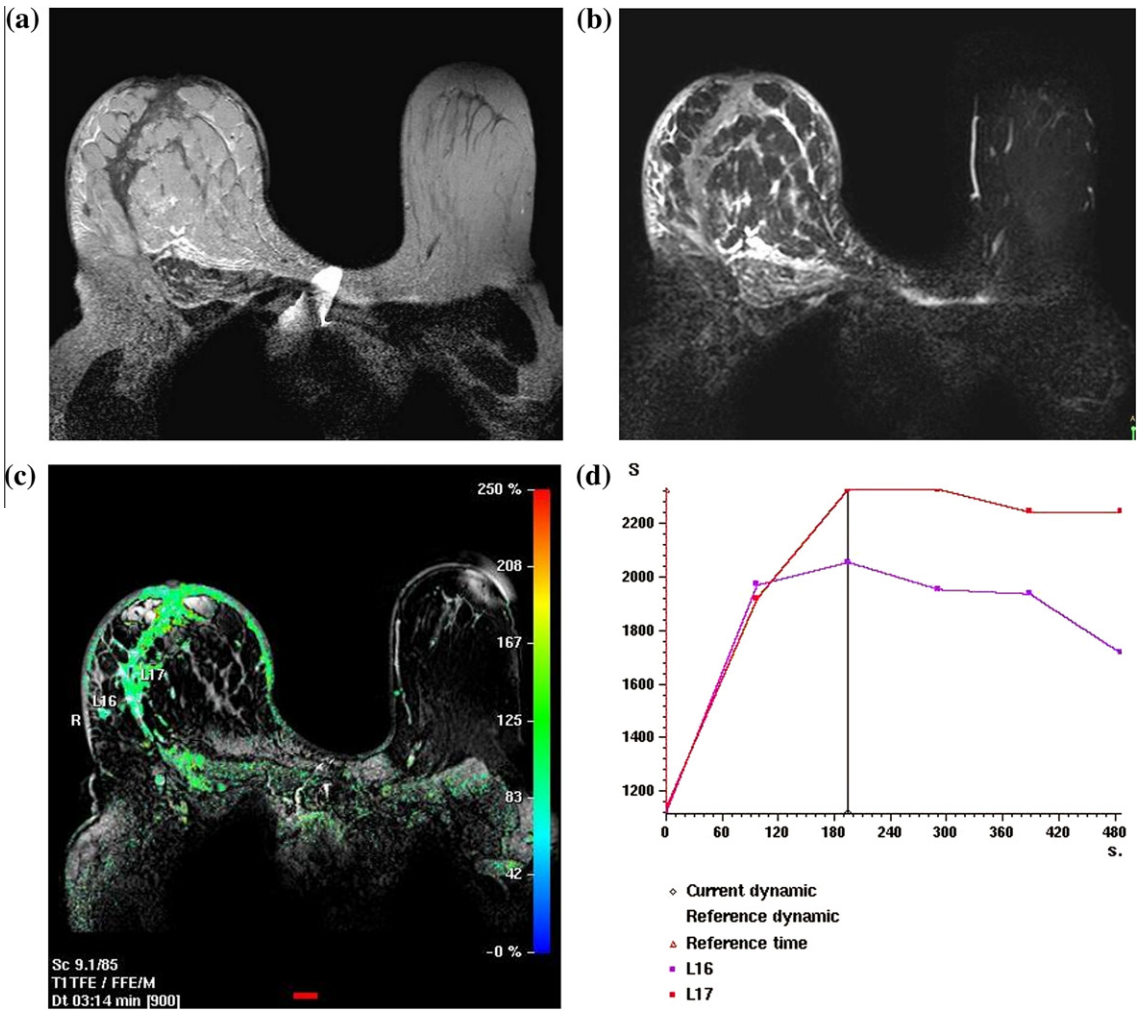

Fig. 5 Right inflammatory breast cancer. Axial (a) T2-weighted and (b) T2-STIR images that show asymmetrical enlargement of the right breast, diffuse soft tissue infiltration and distortion of intermediate-low SI, considered edematous changes, skin thickening, nipple retraction, peri- and intramuscular pectoral edema. (c) Axial THRIVE image 3 min post contrast with color overlay shows intense enhancement of the breast infiltration and avid skin enhancement. Note pectoral enhancement. (d) Time/SI analysis shows early peak of contrast uptake at 190 s. with corresponding SI% of 83–104% and type III (early wash out) curve pattern.

(27.5%) and combined focal and patchy (17.5%) enhancement patterns. The least presentable was the infiltrative diffuse enhancement with dramatic low value of 2.5%. On the other side, malignant mastitis (group 3) mostly had shown infiltrative diffuse enhancement pattern in 80% of these cases ($n = 12/15$).

Quantitative analysis has been a recognizable limitation in the MRI assessment of inflammatory breast disorders. Data had displayed overlap: some benign lesions had shown contrast uptake peak of $>250\%$ and early wash out curve pattern, on the other side some malignant lesions had shown peak of 80–150% and continuous rise curve. Such condition had resulted in upgrading of some benign conditions and consequently had subjected some patients to unnecessary interventional procedures.

The previously mentioned findings may be attributed to that mastitis is a very vascular breast condition whether benign or malignant that displays different variable and overlapping patterns of angiogenesis.

In Inflammatory breast disorders; contrast uptake and kinetic criteria could be used in follow up of chemotherapy. The aforementioned idea is recommended to be thoroughly studied as a continuation to the current work.

Performed MRI examination in our work was able to: (1) Estimate the actual extend of the breast inflammatory disease by making use of the multiplanar capability of the MRI, especially in large lesions that could not be probably assessed by ultrasound. (2) Confirm the nature of the lesion of concern whether being purely cystic, purely solid or complex as sometimes complicated cystic masses may mimic solid lesions on ultrasound examination.

We had to admit that in spite of sometimes MRI was able to differentiate between benign mastitis from malignant entities yet failure to achieve condition improvement had necessitated biopsy no matter what.

Another limitation was the difficulty in differentiating between reactionary and infiltrated axillary lymphadenopathy due to (1) inability to make sure about fatty hilum infiltration in some cases, such finding was much more evident by real-time ultrasound rather than MRI and (2) kinetic criteria was no help as even normal lymph nodes do

Table 4 Patterns of enhancement of the inflammatory breast disorders included in the study.

Mastitis/CE; n = 55/81 cases	Marginal	Discrete patchy	Focal mass	Combined	Diffuse
Group 1: Infectious (n = 20/31)					
Simple	–	3	–	–	–
Abscess	4	–	–	2	–
Infected cysts	7	–	–	–	–
T.B.	1	1	2	–	–
Total	12/20 (60)	4/20 (20)	2/20 (10)	2/20 (10)	–
Group 2: Non-infectious (n = 20/34)					
Periductal mastitis	1	1	–	–	–
Granulomatous mastitis	–	–	–	2	1
Diabetic mastopathy	–	–	–	–	–
Fat necrosis	–	–	5	–	–
Postoperative-chemotherapy	–	3	4	3	–
Scleroderma	–	–	–	–	–
Systemic lupus	–	–	–	–	–
Sarcoidosis	–	–	–	–	–
Total	1/20 (5)	4/20 (20)	9/20 (45)	5/20 (25)	1/20 (5)
Group 3: Malignant (n = 15/16)					
IBC	–	1	1	1	12
Total	–	1/15 (6.7)	1/15 (6.7)	1/15 (6.6)	12/15 (80)

Note: Data are reported as number (percent).
CE = Contrast enhancement.

show shooting contrast uptake and early wash out curve pattern.

During our work, there were some benign examples of mastitis that is likely to be confused with malignancy among those are: fat necrosis, diabetic mastopathy, T.B. mastitis and secondary mastitis due to sarcoidosis, scleroderma and systemic lupus.

Fat necrosis is an example of chronic inflammatory process resulting from injury to breast fat; it is considered the great mimicker of breast cancer (11). When multiple signs typical of fat necrosis are present, Biopsy may be deferred and routine or short-term follow-up may be selected on the basis of the degree of confidence in the imaging diagnosis (12).

In this work fat necrosis was diagnosed in six cases; the following findings were concerned in suggestion: (1) superficial or peripheral location, (2) concordant history of trauma or surgery, (3) signal isointense to fat, and (4) peripheral enhancement. Such variables were based upon a study performed by Daly et al. (12) in 2008.

The association between diabetic mastopathy and type 1 diabetes mellitus of long duration has been reported (13). We had evaluated two cases belonging to such entity one of them had shown focal hard ill-defind mass and the other one presented with diffuse unilateral breast inflammation. Biopsy had confirmed the diagnosis for the two cases.

Tuberculosis is classified as primary when the breast lesion is the only manifestation and secondary when there is demonstrable focus elsewhere (14,15). In the study there were nine breast T.B. cases; all of them had displayed uni-/bilateral pathologically enlarged axillary lymphadenopathy. Five cases had shown diffuse uni-/bilateral interstitial edema, one case had shown abscess cavity (Fig. 2), one case with organized collection and two cases with intramammary enlarged nodes. Three cases had shown additional breast and nodal coarse calcifications. Most of these cases were young (n = 7/9 cases; age range = 22–35 years), small body built and of low socioeconomic level. Again biopsy confirmed the diagnosis as well as positive tuberculin test.

Skin thickening and edema in an untreated breast on MR images, as on mammograms, may be signs of malignancy, especially of inflammatory carcinoma. In a treated breast, these features are frequently observed after radiation therapy (10).

Skin thickening was noted in more than half of the current study cases (n = 45/81–55.5%). Associate avid skin enhancement that may suggest an element of soft tissue infiltration; noted in 46.6% (n = 21/45); most of them were IBC (n = 14/21–66.6%).

In conclusion, Breast MR cannot be used to distinguish infectious/non-infectious mastitis from inflammatory carcinoma. It is difficult to obtain immediate distinction and when mastitis persists after medical treatment, biopsy is necessary.

Dynamic post contrast breast MR can precisely delineate disease extent and monitor response to therapy whether it is medical therapy in benign mastitis or chemotherapy in case of inflammatory carcinoma.

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